MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-519 (project 634) | March 2024

Durable and Constructible Materials in Glass Reinforced Concrete to Efficiently Accommodate Magnetic Fields

the ISSUE

Inductive power transfer systems (IPTS) embedded in concrete panels allow electric vehicles (EVs) to charge their batteries while in motion. However, traditional metallic concrete reinforcement cannot be used, especially in the upper portions of the concrete panels because of the heat and magnetic fields generated by the IPTS. Alternative reinforcement methods must be developed.

the RESEARCH

Four prototype concrete slabs were constructed and monitored during high-cycle fatigue loading. The fatigue cycling used a sinusoidal 2 Hz wave to simulate traffic for a total of 500,000 cycles. After the fatigue tests, each slab was subjected to a static load until failure. The following four alternative slabs were tested: 1) a control slab with no reinforcement in the top of the slab, 2) a slab constructed with fiber-reinforced concrete containing synthetic microfibers, 3) a slab with a top mat of glass fiber reinforced polymer (GFRP) deformed rebar, and 4) a slab with a fiberglass reinforced plastic (FRP) grate used as the top mat of reinforcement. Traditional metallic reinforcement was not an option due to the adverse effects of the magnetic field produced by the IPTS.

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North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

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Project Title

Durable and Constructible Materials in Glass Reinforced Concrete to Efficiently Shape Magnetic Fields

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the FINDINGS

During the fatigue testing, all alternative slabs experienced differing degrees of cracking. External strain gauges were used to monitor the slabs before and after the initial cracking caused by the fatigue testing. Data from the strain gauges were used to compare the deformation due to fatigue damage that occurred in each slab. In addition to the physical testing of the concrete slabs, each alternative slab was modeled in a 3D finite element analysis (FEA) program. The results of the FEA models provided the theoretical ultimate strength of each test slab before they were subjected to fatigue damage. These results were compared with the ultimate residual strengths of the test slabs obtained during physical testing. The data obtained during this research suggest there are several viable top mat reinforcement alternatives, and the FRP grid used as top mat reinforcement provided the greatest durability for the concrete slabs.

the IMPACT

This research is a step toward improved concrete reinforcement for IPTS. Future test-bed designs will draw upon these results to develop infrastructure-embedded power systems for electric vehicles.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1162

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.